Space Weather Technical Forecast

Issued on Thursday 17 October 2024 at 01:17 Local

This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Chance of M-flares. Increasing Chance of G1 Minor Geomagnetic Storms days 1-3 (17-19 Oct).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate with several M-flares observed through the period, with a peak flare of M3.7 at 16/0323 UTC from AR3852.

There are currently six active regions on the visible disc. AR3852 and AR3854 in the southwest quadrant form a coupled pair of sunspots and are the most prominent spot groups on the disc. AR3854 has seen little change recently, but the trailing region on AR3852 has now faded. AR3856 has seen the most notable change in recent hours, increasing in both size and complexity with an increasingly complex magnetic structure. The three remaining regions appear magnetically simple, and generally stable.

No Earth-directed CMEs have been observed in available imagery.

Solar Wind / Geomagnetic Activity: Solar wind speeds varied between background and slightly elevated levels, in the range 370-490km/s. Density was mainly at average to below average levels. The Interplanetary Magnetic Field (IMF), Bt, started moderate then became weak, from around 10 to 6 nT. The Bz component varied in direction throughout, ranging between +7/-8 nT with a favoured trend toward southward orientation. Phi angle was positive (away from the Sun) throughout. Geomagnetic activity was Quiet to Unsettled (Kp 2-3).

Energetic Particles / Solar Radiation: High energy proton flux observed by GOES18 was at background. High energy electron flux (greater than 2MeV) observed by GOES16 was at Background to Moderate with a diurnal peak of 711 pfu at 16/1720 UTC. The associated 24-hour fluence was below the Active threshold. The 17/0000 UTC observation was 1.62e7 total pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Moderate to Low, with a chance of further M-class flares, and a slight chance of isolated X-class flares.

Solar Wind / Geomagnetic Activity: No Earth directed CMEs feature in the forecast. Ongoing slightly elevated solar winds are expected to gradually ease during day 1 (17 Oct). There is then the

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potential for elevated winds to develop from late day 1 until day 3 (17-19 Oct) onwards, due to a high speed stream from the large coronal hole in the northwest of the disc (CH80/+).

Overall, geomagnetic activity is expected to start Quiet to Unsettled (Kp 1-3), with an increasing chance of Active to G1/Minor Geomagnetic storms (Kp 4-5) later day 1 to day 3 (17-19 Oct), as CH80/+ becomes geo-effective.

Energetic Particles / Solar Radiation: High energy proton flux at GOES18 is expected to remain at background, but there remains a very slight chance of enhancement toward S1/Minor storm levels. High energy electron flux may rise to high levels days 1 and 2 (17/18) before being further suppressed by coronal hole fast winds later day 1 or day 2 (17/18) Oct. The associated 24 hour fluence is expected to rise, but thought most likely to remain below Active (1e8 total pfu).

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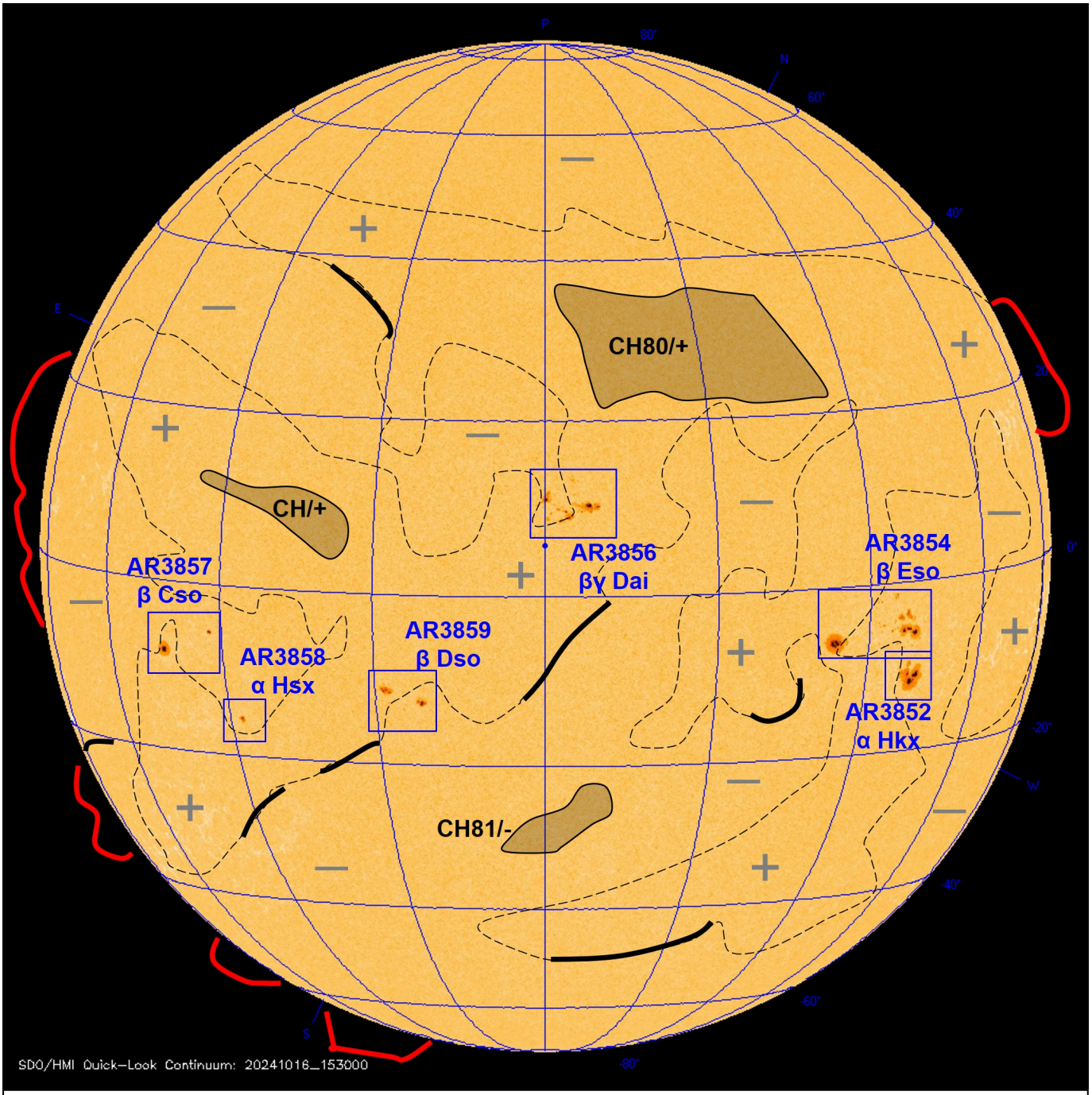
Figure 1: Solar Analysis valid 16/1530 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms

No Earth directed CMEs feature in the forecast. Ongoing slightly elevated solar winds are expected to gradually ease during day 1 (17 Oct) due to waning CME/CH HSS (CH79/+) effects. There is then the potential for elevated winds to develop from late day 1 until day 3 (17-19 Oct) onwards, due to a high speed stream from the large coronal hole in the northwest of the disc (CH80/+). This feature is significantly larger and more clearly defined than the previous rotation, though the lack of evidence of this coronal hole last time makes this forecast low confidence.

MOSWOC ENLIL is thought to be giving generally poor guidance due to the lack of available GONG-H alpha imagery to calibrate initial conditions for the current features on the Sun.

Overall, geomagnetic activity is expected to start Quiet to Unsettled (Kp 1-3), with an increasing chance of Active to G1/Minor Geomagnetic storms (Kp 4-5) later day 1 to day 3 (17-19 Oct), as CH80/+ becomes geo-effective.

Geomagnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	25	30	30	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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Figure 2: SDO AIA imagery showing the large coronal hole in the NW.

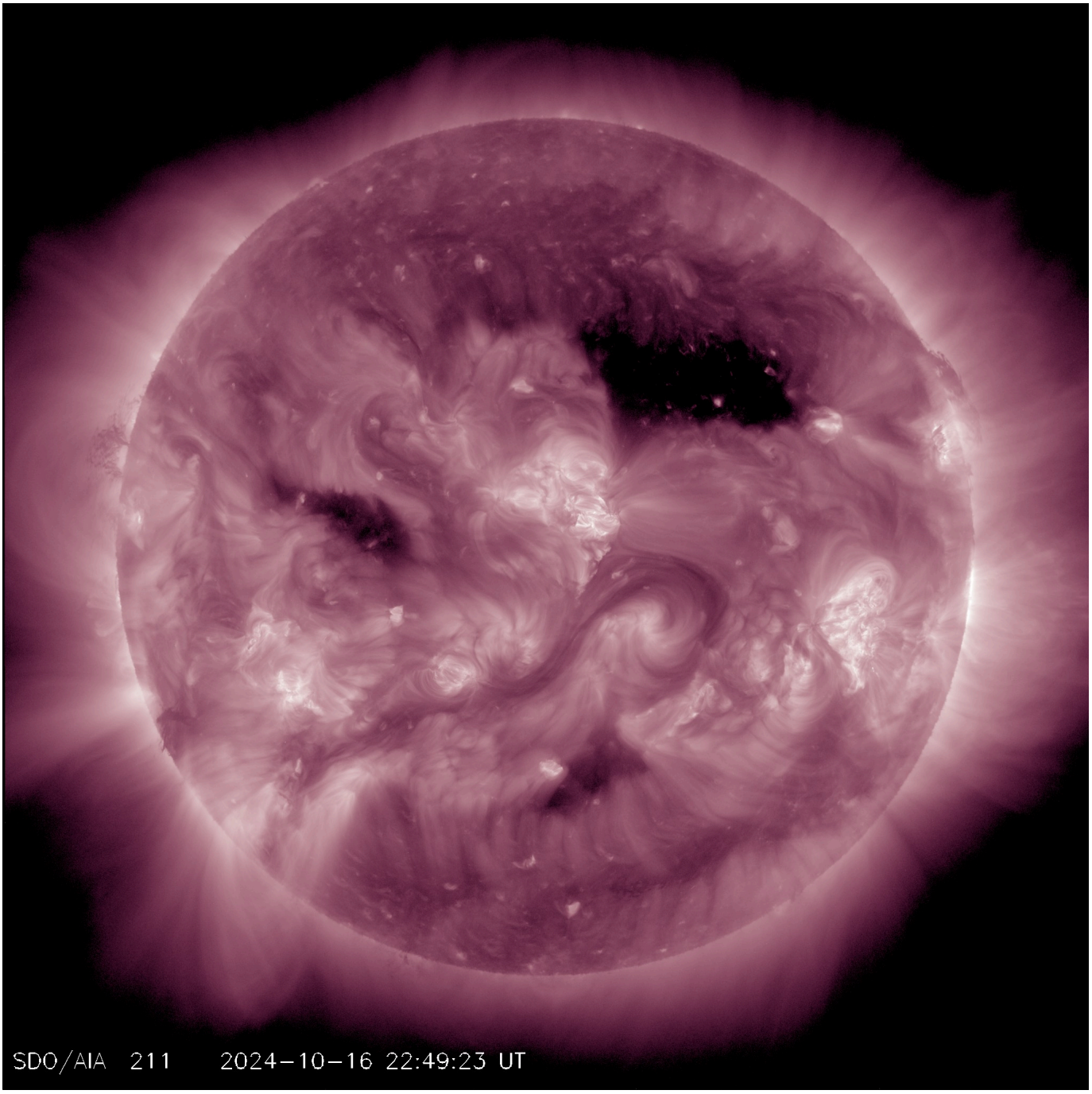

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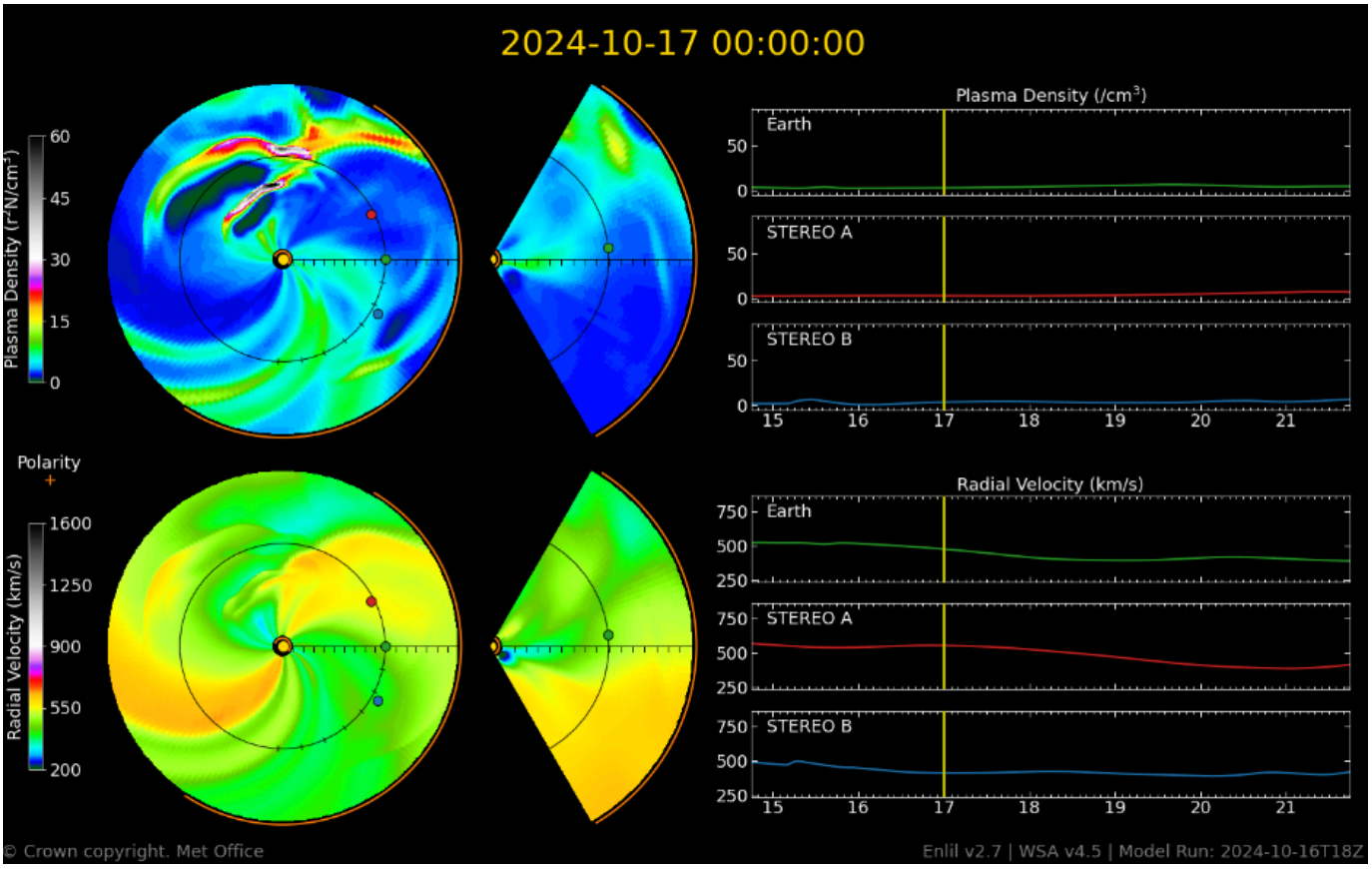
Figure 3:



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Radio Blackouts - X-Ray Flares

Solar activity has been Moderate, with five R1-class M-flares in the period, the largest an M3.7 at 16/0323 UTC from AR3852.

There are currently six active regions on the visible disc. AR3852 and AR3854 in the southwest quadrant form a coupled pair of sunspots and are the most prominent spot groups on the disc, being responsible for the majority of flare activity. Both spot groups have shown small changes in evolution. AR3854 has seen little change recently, but the trailing region on AR3852 has now faded. AR3856 has seen the most notable change in recent hours, increasing in both size and complexity with an increasingly complex magnetic structure. The three remaining regions appear magnetically simple, and generally stable.

Chance of further occasional Moderate flares, with a very slight chance of an isolated X-class flare.

X-Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**R1-R2 (M Class)**	Yes	50	50	50	40
Very Active	**R3-R5 (X Class)**	No	5	5	5	5

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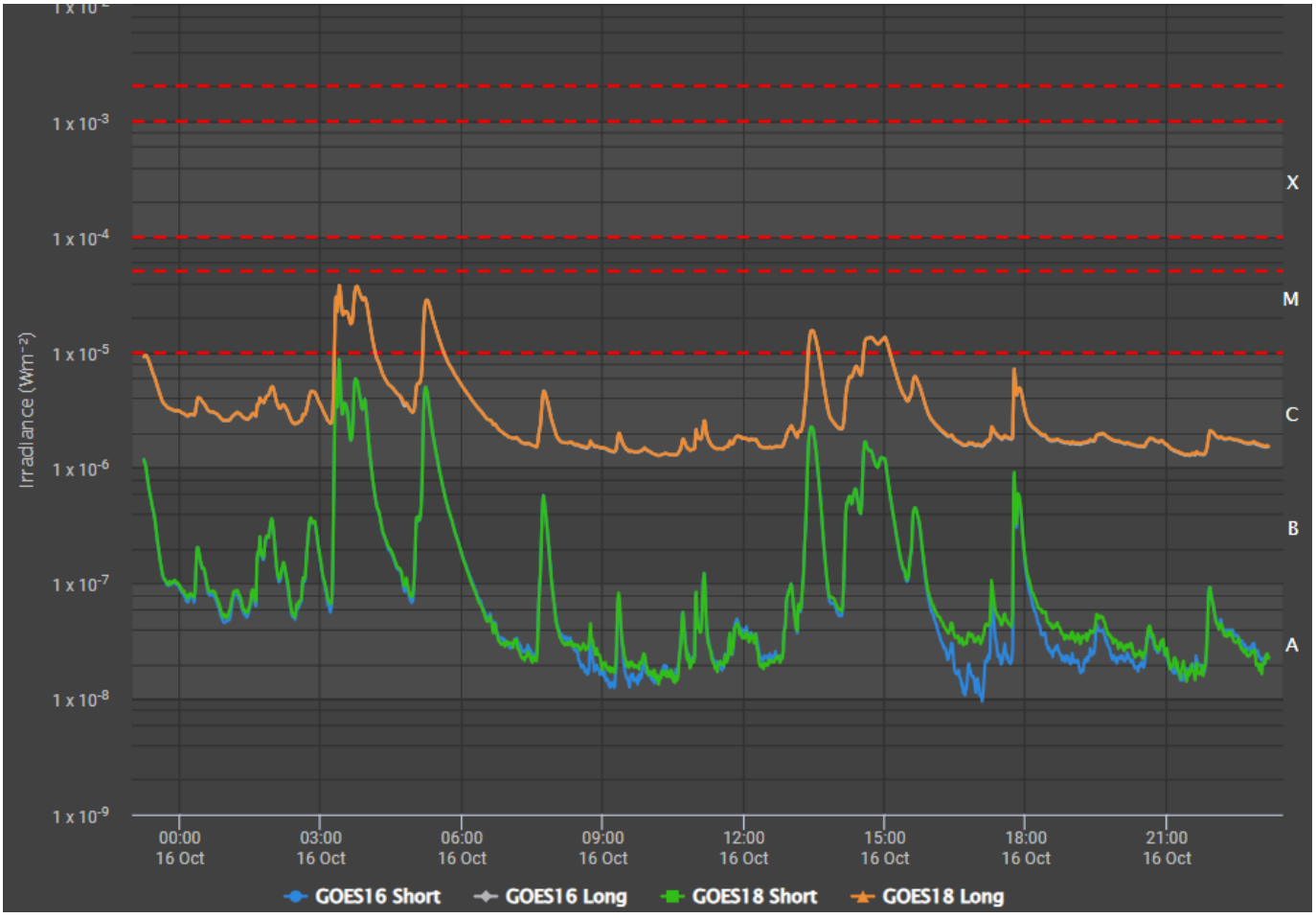
Figure 4: 24 hour X-ray trace



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Solar Radiation Storms (High Energy Protons)

High energy proton flux at GOES18 is expected to remain at background, but there remains a very slight chance of enhancement toward S1/Minor storm levels should any notable flares occur, primarily from any of the three larger spots in the western hemisphere.

Radiation Storms Probability (Exceedance)	Level ($cm^{-2}sr^{-1}s^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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High Energy Electrons (≥ 2MeV)

High energy electron flux (greater than 2MeV) as observed by GOES-16 have been at background to moderate levels. As solar winds ease, flux may rise at GEO to become High. However, this is low confidence, especially with waning CME effects at the start of the period and then a possible high speed stream onset from later day 1 or day 2 (17/18 Oct). Any such enhancement is likely to suppress flux at GEO to background levels again.

The associated electron fluence is therefore expected to be below the Active level (1e8 total pfu), but with a possible rising trend into day 2 (18 Oct). MOSWOC REFM model output is viewed as reasonable guidance at present.

GEO Electron Environment	Level ($cm^{-2}sr^{-1}$ day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ 1×10^{8}	No	10	20	10	10
Very Active	≥ 2 MeV ≥ 1×10^{9}	No	1	1	1	1

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Figure 5: Electron flux (Top) and electron fluence forecast/observations/recurrence (Bottom)

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